Improving Requirement Engineering Process for Web Application Development

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***Abstract*—Web application software development is facing rapid changes in technology accomplishment. An actual goal behind the use of web engineering practices is to achieve the targets like minimization of cost, time and enhancing the quality of a project. Existing software engineering techniques are not fully capable of developing such kind of web applications. Besides the numerous advantages offered by web engineering practices, still there exist important challenges that need to be addressed, one of them is non-prioritized requirements. Failure in the process of requirements prioritization may introduce problems like loss of productivity, increase in time, customer's dissatisfaction and lack of required functionalities. The key objective of this study is to classify the web requirements prioritization process related challenges and provide a suitable prioritization framework to overcome those challenges for web engineering practices. The approach proposed in this study illustrates the benefits of prioritization framework and also addresses the issues exist in current web engineering practices.**

Keywords—Requirement engineering, web engineering, requirement prioritization, value-oriented prioritization.

I. INTRODUCTION

Web applications are developed in a different way as they engage numerous stakeholders, the size and idea of the applications also vary [1]. Web applications require more concentration because of various customers, dynamic behavior and enormous achievement as compared to the conventional applications, where end-users are identified, and their prospects can be easily captured. Developing quality software depends on how well the requirements are specified. The direction in which the requirements should be followed is usually determined in the requirements prioritization phase, which is considered as challenging decision-making practice [2, 3].

From last few years with the increasing use of the internet, the demand for web applications increased significantly. It has greatly changed the way of the development process from traditional software development to modern web-based application development. To gain the advantages introduced by internet rich application, the user community transfer their business from traditional software systems to a web-based system. The nature of the web-based application is quite different from traditional software applications. As different sort of web applications is being developed and introduced in the market, the traditional software development models are not fully suitable for the development of such applications. This change in development trend leads toward a new engineering discipline called web engineering [4]. With the advancement in a web-based application, it is found that the traditional software development methods are not enough for building such kind of applications. This situation provides the foundation for new engineering known as web engineering [5].

Requirements engineering process helps in improving the quality of software products. Various projects became unsuccessful due to glitches in the requirements stage. The purpose of prioritizing requirements is to identify the major requirements for software [6]. It has a significant role in application development when there is a need of an idea for system development and to choose which requirements to incorporate while keeping in mind about the financial plan and time restraints as well as to customer expectation [7, 8]. In many software applications, there are additional candidate requirements that are conceivable to understand within time and economic limitations. Prioritization intents to choose and develop a subsection of these requirements and make a system that delivers the critical requirements and qualifications for the consumers [3]. Thus, choosing the correct requirement from a subset of requirements is a critical phase for developing a software product, as it will aid us to choose valued requirements. Prioritization phase can be completely founded on numerous characteristics such as significance, advantage, price, time and instability. Cost used for prioritizing activity can be in several scales such as a ratio scale or an ordinal scale. Several studies [9, 10] have highlighted and analyzed the importance of requirement prioritization phase in the successful development of overall software development project. Many techniques assist the requirements prioritization procedure through technical aspects. Though, value-oriented prioritization (VOP) is the single method that addresses both businesses as well as technical aspects for requirements prioritizing phase [6]. VOP presents the type of an additive weighting technique that is described by using Wiegers spreadsheet model [12, 13]. It emphasizes fundamental business values according to

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the firms' structure. It deliberates the significance of integrating business core value in "ordering the stories" in preparation approach for Extreme Programming [14]. VOP provides a clarification to the ordering problem. VOP structure helps the requirement team effectively by providing them with the fundamentals necessary for requirement prioritization and decision-making process. The VOP method consists of two main stages for prioritization. Initially, the organization should describe their business values along with the scores associated with these values. This stage results in constructing the Framework. In the next stage, these core values are used as an aid to requirement prioritization framework and provide help in applying the Framework.

VOP framework is used to recognize the fundamental principles of business and the comparative relationship among those values. It is based on three levels of software model: user, business and functional. It further uses the fundamental business values to rank requirements and guarantees their traceability. The role of business executive here is to identify core business values and provide weight to these values according to their importance for the current business using a simple ordinal rule. The initial phase in scheduling a value-oriented ranking process is to create the framework that is used to detect the values of the business and the comparative connection of those values. Corporate values are selected at the level of the firm. Once the fundamentals values are detected and finalized, the firm must deliver some suggestion on the significance of those values to the business. It is achieved by allocating weights to those values using an ordinary scale ranging from 0 (minor) to 10 (critical) [15].

Despite the existing features and numerous advantages offered by web engineering practices, it also possesses many challenges. Literature shows that challenges existing in web engineering practices include failure to meet business needs, missing requirements, project schedule delays, lack of required documentation, budget overrun, short deadlines not meet, lack of required functionality and customer unsatisfied [13, 16, 17], so there is a need to prioritize the requirements in web development. It is observed that in web engineering domain, various models have been used but still, above-mentioned issues of web engineering practices exist due to a poor prioritization process. It shows the need for a proper prioritization framework for web engineering practices. The development and utilization of such a prioritization framework are essential to overcome these issues [18].

The remaining paper is organized in such a way that: Section 2 presents the literature review, Section 3 elaborates the proposed approach, Section 4 presents the conclusion and Section 5 presents the future work.

II. Literature Review

A unified framework was proposed in a study that combines some of the existing agile methodologies along with web engineering principles, core business values are used in the study for the successful delivery of required features. The outcomes of the industrial experience, based on the framework, are very encouraging and the indication that this kind of approach will be very suitable for web projects. This paper also discusses the importance of requirements in agile web projects, but do not provide any solution of scalability and short deadlines in requirements prioritization [15].

A conceptual framework is proposed in [19]. It has outlined some important factor and their effect on requirements prioritization process in case of agile development methods. The findings of the study highlighted three core aspects that are involved in requirements prioritization process in agile development including Environment, Process, and Product. However; there is a need to empirically evaluate the interrelationship existing between these factors and their impact. Further, there is a need to conduct a systematic approach for requirements prioritizing in agile process development.

This study [3, 20] proposed a novel technique that is used for the decision-making process and also proposed a tool for requirements prioritization using AHP technique. However; findings of the study show that still, these methods suffer some problems such as scalability issues, requirement inconsistency or sometimes disagreement between the weights assigned to requirements.

This study presented an experimental approach aiming at analyzing two state-of-the-art tool-supported prioritization techniques, AHP and CBRank. It indicates that for the first two characteristics like the ease of use and time CBRank defeats AHP but in case of correctness AHP's performance is better than CBRank, even if the resulting ranks from both the ways are very same two prioritization methods are compared but still some issues are not addressed e.g. scalability, customer dissatisfaction in web software development [21].

Another study has evaluated the cause of lack of requirements analysis in web development. According to this study, the developer's main focus is on implementation and testing and prior phases of development are neglected. In addition, another problem highlighted in this study is the lack of paying attention to requirement analysis activity[22].

Another study analyzed that incorrect management of requirement is a reason for failure in web projects. The main cause behind the lack of success of projects is mainly to be spotted in the process of Requirements Engineering as presented by multiple surveys of the Standish Group. Further, it is caused by skipped or insufficient requirements [23].

[7, 24] analyzed that quick changes in the technologies also affect renovation in the web systems. Latest web technologies and web development principles bring a new challenge for a web developer. The study also highlights that the model and functionality of a web-based system also evolve constantly. Managing the web-application with changing needs and demands is one of the challenging managerial, technical and administrative issues.

Above literature shows that there exist various studies that have addressed the issues of requirements analysis phase within Web engineering domain. However, still there exist some issues related to requirement prioritization process that need to be addressed.

III. Proposed Approach

In this section, our proposed approach has been elaborated. On the basis of comprehensive literature review, we concluded that a successful requirement prioritization framework can be used as a solution for overcoming the

issues faced by web engineering practices that occurred during the requirements analysis phase. Below is the brief description of steps that we followed in our approach as shown in Fig.1.

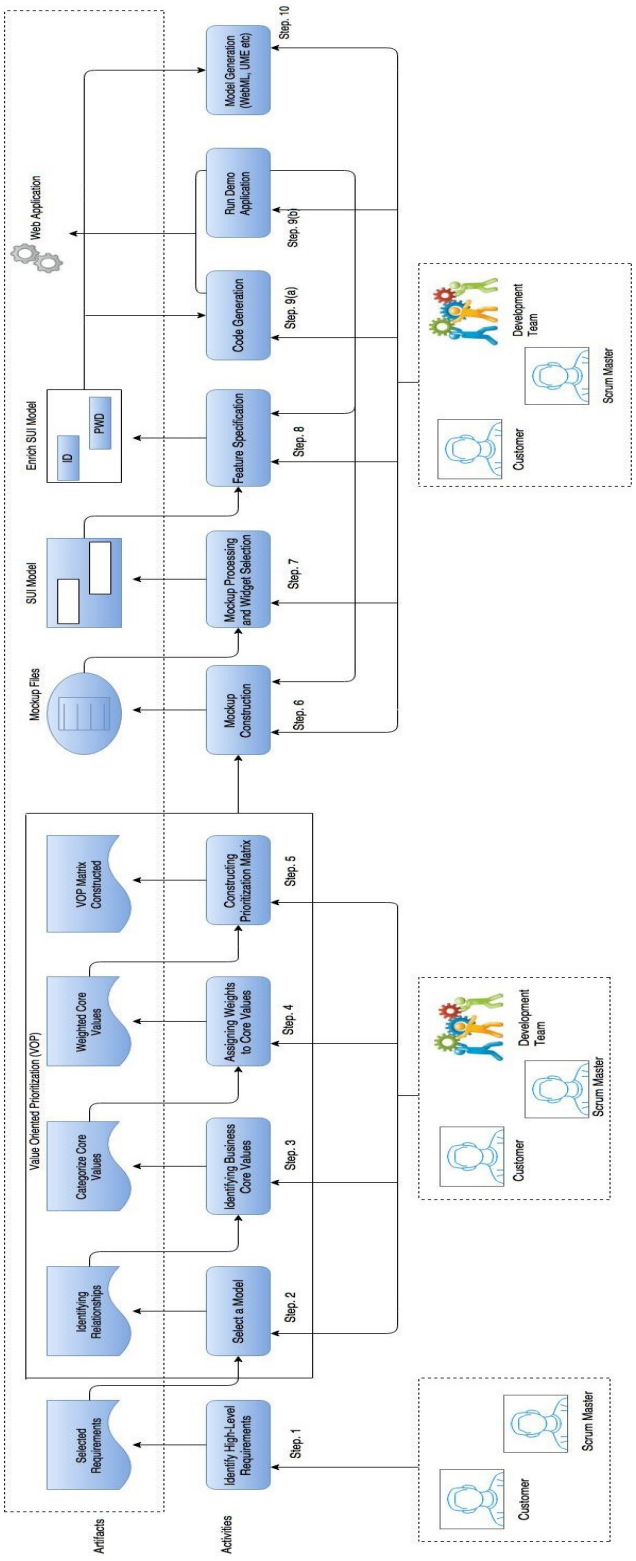

Fig. 1. Prioritization Framework

i. Identifying High-Level Requirements

The first step of the proposed approach is to identify high-level requirements after discussion among all stakeholders. We have followed the VOP approach. VOP model helps the requirement engineer by providing the base needed to prioritize and make requirements related decisions. It's centered on Karl Wiegers three stages of software requirements: user, functional and business [25, 26].

ii. Identifying Business Core Values

This step involves identifying core business values along with their requirements. After negotiation between the customer and scrum master, these core values were identified and categorized based on their requirements and the virtual association of those values.

iii. Assigning Weights to Core Values

This phase consists of assigning weights to the identified values by using a simple ordinal range from 0 (minor) to 10 (very important). This is an individual ranking, so the discussion included considerable disputation. On the other hand, the process recognized relative values that all stakeholders like a customer, scrum master, and the development team eventually agreed will reflect the required system priorities.

iv. Constructing Prioritization Matrix

To use the proposed framework, there is a need of prioritization matrix. Table 1 shows a sample of a matrix having core business principles and requirements. Vi is the weight of a business value. Wi,j is the weight allocated to requirement ri regarding business value Vj. Officially, we can express in Equation 1 the value for every requirement as:

$$\forall r \in \{R\}: Sr = \sum_{i=1}^{n} (V_i \times W_{r,i}) \quad \text{Equation.1 [27]}$$

TABLE I. EXAMPLE OF VOP MATRIX [28]

Req.	Business Value (V1……Vn)					Score
	Security	Integrity	Speed	24-Hours	Customer Satisfaction	
	V1	V2	Vi	Vi+1	Vn	
R1						
R2			Wi,j			
.						
.						
Rn						

We can demonstrate the score for every requirement in each system by calculating its value. The value for each requirement is calculated by multiplying the ratings in every category with the weight assigned to that category in the preceding phase. After that we find score against all requirements and we select top scored requirements as a final prioritized list.

v. Mockup Construction

The mockup is a process of clarification of conceptual user interface design for the given requirements and outcomes in a practical way, through constant simulation of the UI. Mockups are formed to display your client the complete look of the new website. A website mockup is a good way to submit your design for acceptance to your customer. Adobe Photoshop or HTML is a fast and easy way for the creation of your design by providing an effective way of making corrections or repositioning your design with a small amount of effort

vi. Mockup Processing and Widget Selection

This step involves building a domain model in order to formalize user interface structure. To do this, we used SUI meta-model [29, 30]. The use of SUI meta-model in MockupDD is quite similar to UI description languages and standards like XAML5 and XUL6 [31]. It defines and uses a Widget abstract class; widgets may be classified as either Simple Widgets (atomic) or Composite Widgets (container widgets), and these widgets are grouped in the form of navigational units (Pages) [32].

vii. Feature Specification

In this step, we enriched mockup in a different way by using SUI models and specifying requirements using the tag. In our approach, a tag is an atomic object that is composed by a name and having zero or more parameters. Tag are of different types, and each tag may be applied over a subset of SUI widgets. Further, there is a custom syntax option for each tag parameter that extends its semantics according to as per required.

viii. Code Generation

In this phase, the code generation module is used to generate code from a higher-level model like enrich SUI model to create a working application. For example, if you can generate websites, you can give a client the code needed to run their website.

ix. Running Web Application

This phase takes the result of all the above-mentioned phases as an input in the form of models. These models further generate final Web Application with the help of code generation module. At this stage, a demonstration of the running application can be given to end-users or customers by running the application. From this demo and modeling did, the behavior of the application can be visualized.

x. Model Generation

The last step of the proposed framework is generating a complete model. While generating a model from enriching SUI model, you must give your client a runtime engine which allows him to implement a whole class of applications.

IV. CONCLUSION

With the growing use of internet applications, development trends are also shifted from traditional desktop applications towards web-based applications. Web engineering is an emerging engineering discipline and still not much mature as compared to other software engineering methodologies. Web engineering practices face many issues during the requirement engineering phase. One of the core issues that need to be addressed is prioritizing the requirement.

The intention behind this research study was to pinpoint and resolve the prioritization issues for web engineering practices to overcome prioritizing requirements related challenges. The growth of agile software engineering approach helps us in addressing the rapid changes in requirements and releasing product iterations in a short time. Failure in process of prioritizing requirements in the system may introduce problems like productivity loss, time, customer's dissatisfaction, and lack of required functionalities and sometimes the loss of whole business.

Literature shows that existing software engineering techniques are not fully capable of addressing these issues in the context of web applications. Our proposed prioritization framework for web engineering practices successfully address the issues that arise during requirement analysis phase including requirements negotiation and software release planning. This study highlights and illustrates the benefits of the proposed prioritization framework by addressing the issues faced while using existing practices of web engineering.

V. FUTURE WORK

As a future work, our aim is to extend the proposed framework by adding new practices in the proposed prioritization framework. We aim to further extend this research by proposing a tool for the distributed environment that will help the researchers and practitioners in addressing the issues that are faced while using existing requirement prioritization practices for web application development. We are also planning to conduct a case study and will get an expert judgment from the industry for the evaluation of the proposed approach. The aim of the case study is to explain the proposed methodology in detail by creating a management system. We will collect data from industrial practitioners using a questionnaire. We will target a well-known and experienced web-based IT industry for data collection.

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